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Magnetic field effects in optical and far IR spectra of LiTmF4 crystals

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Abstract

Splitting of the first excited Γ34 1 (3H6) doublet state of Tm3+ ions in the LiTmF4 crystal in external magnetic fields up to 11 T has been studied using measurements of luminescence and far infrared absorption spectra at low temperatures. In the magnetic field perpendicular to the S4-symmetry axis of the crystal lattice, the splitting of the non-Kramers doublet is caused by the joint action of the nonlinear Zeeman effect and the piezospectroscopic effect related to parastriction. Experimental dependences of the doublet splitting on the magnetic field strength and direction are in good correspondence with the theoretical estimations obtained in the framework of the semiphenomenological crystal field model. It is shown that spectroscopic data present direct information on the forced magnetostriction in the basal plane of uniaxial Van Vleck paramagnets that contain non-Kramers rare earth ions.

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Keywords

Crystal field, Electron-lattice interaction, LiTmF4, Parastriction, Van Vleck paramagnets